Comparison of the Current Drafts of RTCA DO-181D and Eurocae ED-73C "Test Procedures Related to Receiver and Transmitter"

RTCA DO-181D Section	Eurocae ED-73C Section	Section Title	DO-181D Comments	ED-73C Comments
2.4.2.1	5.4.1	Receiver Characteristics	DO-181 includes Mode S low-level reply ratio test	
2.4.2.2	5.4.2	Transmitter Characteristics		ED-73 separates Mode A/C and Mode S continuous reply rate capability tests
2.4.2.3	5.4.3	Reply Pulse Characteristics	Comparable	
2.4.2.4	5.4.4	Side Lobe Suppression	Comparable	
2.4.2.5	5.4.5	Pulse Decoder Characteristics	Comparable	
2.4.2.6	5.4.6	Transponder Desensitization and Recovery	Comparable	
2.4.2.7	5.4.7	Response to Interference		ED-73 includes additional tests for: (1) standard interference pulse positioned at Mode A or Mode C spacing before P1 of Mode S interrogation, and (2) Mode A and Mode C with standard interfering pulse
2.4.2.8	5.4.8	Undesired Replies	Comparable	
2.4.2.9	5.4.9	Self-Test and Monitors	Comparable	
2.4.2.10	5.4.10	Interference Suppression Pulse Response	Comparable	
2.4.2.11	5.4.11	Diversity Operation	Comparable	
2.4.2.12	5.4.12	Data Handling and Interfaces		ED-73 includes additional tests for invalid AA
2.4.2.12.5	5.4.13	Interface Integrity Testing	Comparable	
---	5.4.14	Power Interruption		Tests not in DO-181

Comparison of the Current Drafts of RTCA DO-181D and Eurocae ED-73C "Test Procedures Related to Receiver and Transmitter"

RTCA DO-181D Section	Eurocae ED-73C Section	Section Title	DO-181D Comments	ED-73C Comments
2.5.4.1	5.5.8.1	Error Protection	Comparable	
2.5.4.2	5.5.8.2	Interrogation Acceptance Tests	Comparable	
2.5.4.3	5.5.8.3	CA Verification	Comparable	
2.5.4.4	5.5.8.4	Non-selective Lockout Tests		ED-73 has 3 more patterns in the II/SI discrimination test
2.5.4.5	5.5.8.5	Selective Lockout Tests		ED-73 has more test patterns
2.5.4.6	5.5.8.6	Squitter Verification	DO-181 has additional tests for: (1) Acquisition Squitter, (2) Extended Squitter, (3) Extended Squitter Rate, (4) Extended Squitter Protocol, and (5) Squitter Control	
2.5.4.7	5.5.8.7	FS and VS Protocol	DO-181 includes 64 transactions for "Basic Option" transponder	
2.5.4.8	5.5.8.8	PI Verification	Comparable	
2.5.4.9	5.5.8.9	Address Tests		ED-73 defines test patterns for level 1, level 2, and higher transponders
2.5.4.10	5.5.8.10	Altitude Report Tests	Comparable	
2.5.4.11	5.5.8.11	4096 Code Tests	Comparable	
2.5.4.12	5.5.8.12	RI, Acquisition, and Maximum Airspeed	Comparable	
2.5.4.13	5.5.8.13	PR, Probability of Reply, Stochastic Acquisition	Comparable	
2.5.4.14	5.5.8.14	Not used	Not used	

RTCA DO-181D Section	Eurocae ED-73C Section	Section Title	DO-181D Comments	ED-73C Comments
2.5.4.15	5.5.8.15	Comm-A, Interface and Control	Comparable	
2.5.4.16	5.5.8.16	Broadcast Formats		ED-73 includes a test with UF=11 interrogation
2.5.4.17	5.5.8.17	Downlink Interface. DF=0,16	Comparable	
2.5.4.18	5.5.8.18	Comm-B Protocol	Comparable	
2.5.4.18A	5.5.8.19	Enhanced Comm-B Protocol		DO-181 includes UM field tests
2.5.4.19	5.5.8.20	AIS Flight Identification	Comparable	
2.5.4.20	5.5.8.21	Extended Capability Report	Comparable	
2.5.4.21	5.5.8.22	Directed Comm-B	Comparable	
2.5.4.21A	5.5.8.23	Comm-B Broadcast		ED-73 includes test for transponder-initiated broadcast
2.5.4.22	5.5.8.24	Downlink Interface, Storage Design, Buffer Rate	Comparable	
2.5.4.23	5.5.8.25	Downlink Interface, No Storage Design,	Comparable	
2.5.4.24	5.5.8.26	Comm-C Protocol	Comparable	
2.5.4.24	5.5.8.27	Enhanced Comm-C Protocol	Comparable	
2.5.4.25	5.5.8.28	Uplink Interface, ELM-Comm-C	Comparable	
2.5.4.26	5.5.8.29	Comm-D Protocol	Comparable	
2.5.4.26	5.5.8.30	Enhanced Comm-D Protocol	Comparable (note that DO-181 combines Comm-D and Enhanced Comm-D test sections)	
2.5.4.27	5.5.8.31	Directed Comm-D	Comparable	
2.5.4.28	5.5.8.32	Comm-D Interface, Rate and Content	Comparable	
2.5.4.29	--	Not used	Not used	

RTCA DO-181D Section	Eurocae ED-73C Section	Section Title	DO-181D Comments	ED-73C Comments
--	5.5.8.33	Comm-U Uplink Interface	DO-181 does not include these tests	
2.5.4.30	5.5.8.34	Sensitivity Level Operation	Comparable	
2.5.4.31	5.5.8.35	Transmission of RA Report to Mode S Sensor	Comparable	
2.5.4.32	5.5.8.36	Transmission of TCAS Capability to Mode S Sensor	Comparable	
2.5.4.33	5.5.8.37	TCAS or Transponder/TCAS Interface Failure….	Comparable	
2.5.4.34	5.5.8.38	Coordination	DO-181 has separate tests for TSO-C119A and DO-185A compatible TCAS units	
2.5.4.35	5.5.8.38	MU Messages to TCAS	DO-181 has separate test section, ED-73 tests included in “coordination” section	
???	5.5.8.39	ACAS Broadcast Message		Unclear if the ED-73 tests are included in DO-181
2.5.4.36	5.5.8.40	Transponder Replies to Incoming TCAS RAs	Comparable	
2.5.4.37	5.5.8.41	Transponder/TCAS Throughput	Comparable	
2.5.4.38	5.5.8.42	Transponder Communication Timing	Comparable	
2.5.4.39	5.5.8.43	TCAS Crosslink	Comparable	
--	5.5.8.44	Mode S Transponder Hijack Mode		DO-181 does not contain these tests

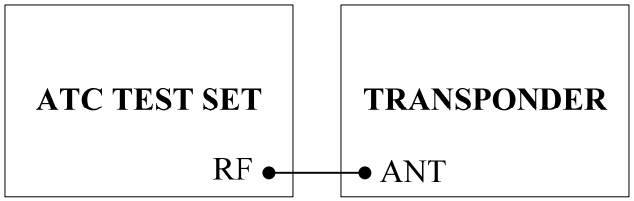
Comparison of the Current Drafts of RTCA DO-181D and Eurocae ED-73C "Test Procedures Related to Receiver and Transmitter"

Detailed Differences Table follows on the next page:

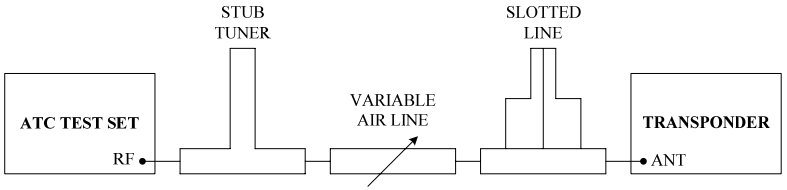
TEXT in blue differs from the opposing standard

Highlighted text was highlighted in the draft of DO-181D to note text changed from DO-181C.
Note some highlighted text is blue, indicating differences in the respective document.

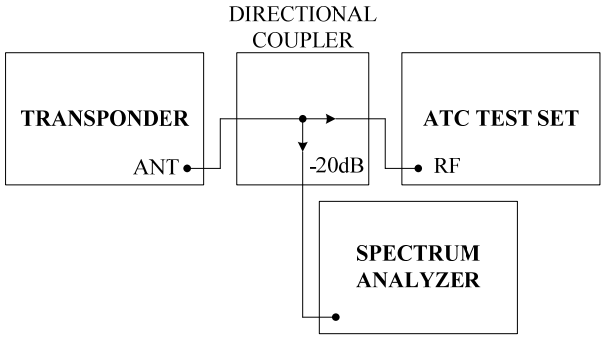
Resolutions, Agreements and Action Item notes are highlighted in Turquoise

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
2.4.2.1 Receiver Characteristics (§ .) Step 8. Includes Mode S low level reply ratio test Equipment Required: ATC Test Set with P_4 Capability (TIC T-50-3A/4B, or equivalent) Measurement Procedure: With the equipment connected as shown in Figure 2-24, interrogate the transponder with a standard Mode A interrogation and follow Steps l through 4 below.  **Figure 2-24:** ***Note:*** *The power can be measured either at the antenna or at the LRU (if corrections for cable loss are included).* Step 1 Sensitivity Variation with Frequency (§ .) Vary the RF signal frequency over the range 1029.8 to 1030.2 MHz. Use a frequency increment that includes 1030.0 MHz. Determine the variation in RF signal level that is required to produce 90 percent transponder reply efficiency. Also determine the required maximum RF signal level. Step 2 Sensitivity (§ . a and e) Connect the equipment as shown in Figure 2-24. Interrogate the transponder with a standard Mode A interrogation. Determine the minimum RF signal level required to produce 90 percent transponder reply efficiency. Repeat the procedure using a standard Mode A ATCRBS/Mode S All-Call interrogation and a standard Mode C ATCRBS/Mode S All-Call interrogation. Determine MTL for all cases. This is the ATCRBS MTL. Step 3 ATCRBS and ATCRBS/Mode S All-Call Dynamic Range (§ ..f) Repeat Step 2 for RF levels in 5 dB intervals between MTL +3 dB and -21 dBm. Determine reply ratio.	**5.4.1 Receiver Characteristics (Paragraph .)** **5.4.1.1 Test Equipment Transponder Test Set** **5.4.1.2 Test Procedure** Connect the equipment as shown in Figure 5-1. Follow steps 1 through 7, below: a. STEP 1 - Sensitivity Variation with Frequency (Paragraph .) Interrogate the transponder with a Mode A interrogation. Vary the RF signal frequency over the range 1 029.8 to 1 030.2 MHz. Record the minimum and maximum RF signal levels required to produce 90% transponder reply efficiency. b. STEP 2 - Sensitivity (Paragraph . a and e) Interrogate the transponder with a Mode A interrogation. Record the minimum RF signal level required to produce 90% transponder reply efficiency. Repeat the procedure using : - a Mode C interrogation, - a Mode A/Mode S All-Call interrogation and - a Mode C/Mode S All-Call interrogation. This determines the MTL for these interrogations. c. STEP 3 - Mode A/C and Mode A/C/S All-Call Dynamic Range (Paragraph . f) Interrogate the transponder with a Mode A interrogation. Vary the RF level in 5 approximately equal steps between MTL and -21 dBm. Record the reply ratio at each step.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
Step 4 Bandwidth (§ .) Adjust the RF signal level to 60 dB above MTL. Determine the frequencies above and below 1030 MHz at which 90 percent transponder reply efficiency is obtained. ***Note:*** *Care must be taken to avoid high signal levels at or near center frequency.*	Repeat the procedure using : - a Mode A/Mode S All-Call interrogation and - a Mode C/Mode S All-Call interrogation. d. STEP 4 - Bandwidth (Paragraph .) Interrogate the transponder with a Mode A interrogation. Adjust the RF signal level to 60 dB above MTL. Record the frequencies above and below 1 030 MHz at which 90% transponder reply efficiency is obtained. ***NOTE:*** *Care must be taken to avoid high signal levels at or near the centre frequency.*
Step 5 ATCRBS and ATCRBS/Mode S All-Call Low-Level Reply Ratio (§ ..d) Repeat Step 2 for an RF level of -81 dBm. Determine reply ratio. ***Note:*** *The following steps require the use of test equipment having the capabilities set forth in § ..i.*	e. STEP 5 - Mode A/C Mode A/C/S All-Call and Mode S-Only All-Call Low-Level Reply Ratio (Paragraph . d) With a RF signal level of -81 dBm, interrogate the transponder with: - a Mode A interrogation, - a Mode A/Mode S All-Call interrogation, - a Mode C/Mode S All-Call interrogation, and - a Mode S-Only All-Call interrogation with PR = 0. In each case record the reply ratio.
Step 6 Mode S Sensitivity (§ ..b) Interrogate the transponder with a Mode-S Only All-Call interrogation at a standard rate with PRO. Determine the minimum RF level to produce 90 percent proper reply efficiency.	f. STEP 6 - Mode S Sensitivity (Paragraph . b) Interrogate the transponder with a Mode-S Only All-Call interrogation with PR=0. Record the minimum RF level to produce 90% reply efficiency. This is the MTL for this interrogation.
Step 7 Mode S Dynamic Range (§ ..c) Using the signal specified in Step 6, determine the reply efficiency for RF levels between MTL +3 dB and -21 dBm; use 5 dB steps.	g. STEP 7 - Mode S Dynamic Range (Paragraph . c) Interrogate the transponder with a Mode-S Only All-Call interrogation with PR=0. Record the reply ratio at RF levels of MTL+3dB, -50 and -21 dBm.
Step 8 Mode S Low-Level Reply Ratio (§ ..d) Using the signal specified in Step 6, determine reply efficiency for an RF level of -81 dBm.	Appears to be equal in step “e” 5.
2.4.2.2 Transmitter Characteristics (§ .) ***Reply Transmission Frequency (§ .)*** Equipment Required: ATC Test Set with P_4 capability (TIC T-50-3A/4B, or equivalent). Stub Tuner (Microlab/FXR Sl-05N, or equivalent). Variable Air Line (Line Stretcher) (Microlab/FkR SR-05N, or equivalent). Slotted Line (HP 805C, or equivalent). Measurement Procedure:	**5.4.2 Transmitter Characteristics (Paragraph .)** **5.4.2.1 Reply Transmission Frequency (Paragraph .)** ***5.4.2.1.1 Test Equipment*** a. Transponder Test Set b. Stub Tuner. c. Variable Air Line (Line Stretcher) d. Slotted Line. ***5.4.2.1.2 Test Procedure*** Connect the equipment as shown in Figure 5-2. Adjust the stub to establish a 1.5:1 VSWR at the antenna end of the coaxial line

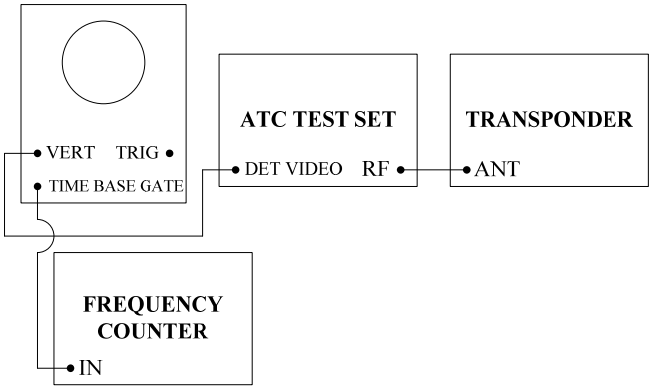
DO-181D version 0.6	ED-73C after WG-49 Meeting 9
Connect the equipment as shown in Figure 2-25. Adjust the stub to establish a l.5:l VSWR at the antenna end of the coax line specified by the manufacturer. If the transponder requires a minimum length of a specified cable type, an attenuator equal to the loss of the minimum amount of cable may be placed between the 1.5:1 VSWR point and the transponder antenna jack. Alternately, a length of cable equal to the specified minimum length and cable type may be used in lieu of the attenuator. Interrogate the transponder with a standard Mode A interrogation and adjust the line stretcher to determine the maximum and minimum transmitter frequency. Use a 14 (7777) pulse reply group. Repeat the above procedure with a standard Mode A ATCRBS/Mode S All-Call at standard rate only. Determine that the frequency shift does not exceed the requirements of § ..	specified by the manufacturer. - If the transponder requires a minimum length of a specified cable type, attenuation equal to the loss of the minimum amount of cable may be placed between the 1.5:1 VSWR point and the transponder antenna jack. - Alternatively, a length of cable equal to the specified minimum length and cable type may be used in lieu of the attenuator. Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate the transponder with a Mode A interrogation and adjust the line stretcher for maximum transmitter frequency shift above or below 1 090 MHz. Record the frequency shift in each case. Repeat the above procedure with a Mode A/Mode S All-Call.
 **Figure 2-25:**	
RF Peak Power Output (§ .) Equipment Required: ATC Test Set with P_4 capability (TIC T-50-3A/4B, or equivalent). Wide Band Dual Channel Oscilloscope (HP 1710B, or equivalent). Measurement Procedure: Step l ATCRBS Power Output (§ .) Connect the equipment as shown in Figure 2-26. Set the transponder for a 14 (7777) pulse reply. Interrogate the transponder with a standard Mode A interrogation and measure the single pulse having the least RF power output. While varying the interrogation rate from 100 interrogations per second to the maximum interrogation rate specified for the transponder, determine that the power output meets the requirements of § .. Step 2 Mode S Power Output (§ .) Repeat Step l with a standard Mode A ATCRBS/Mode S	**5.4.2.2 RF Peak Power Output** (Paragraph .) ***5.4.2.2.1 Test Equipment*** a. Transponder Test Set b. Wide Band Dual Channel Oscilloscope. ***5.4.2.2.2 Test Procedure*** Connect the equipment as shown in Figure 5-3. a. STEP 1 - Mode A/C Power Output (Paragraph .) Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate the transponder with a Mode A interrogation and record the peak power level of the single reply pulse having the least RF power level. While varying the interrogation rate from 100 interrogations per second to the maximum interrogation rate specified for the transponder, record the variation in peak power level of the single reply pulse having the least RF power level. Repeat the procedure, recording the level and variation in peak power level of the single reply pulse having the highest RF power level. b. STEP 2 - Mode S Power Output (Paragraph .)

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
All-Call interrogation at standard rate only. ***Section 5.4.2.3 is satisfied in DO-181D in §2.2.4.3.2 and §2.4.2.3.4***	Repeat STEP 1 with a Mode A/Mode S All-Call interrogation at standard rate only. For transponders with long reply capability, repeat STEP 1 with a Mode S interrogation, using any format and coding for which a long reply is required. **5.4.2.3 Transmitter Spectrum** (Paragraph .) ***5.4.2.3.1 Test Equipment*** a. Transponder Test Set. b. Spectrum Analyser. c. Directional Coupler. ***5.4.2.3.2 Test Procedure*** Connect the equipment as shown in Figure 5-4. a. STEP 1 - Mode A/C Set the transponder for a 14 pulse reply (Mode-A code 7777). Interrogate on Mode A at 500 interrogations per second, and verify that the reply efficiency exceeds 90% Measure and record the spectrum of RF emission at the antenna terminal of the transponder over the range 150 kHz to 10 GHz. b. STEP 2 - Mode S Repeat Step 1 with Mode S "All-Call interrogation". Record the maximum response in each frequency band as a ratio expressed in dB relative to the centre band peak level.
Unwanted Power Output (§ . and § ..f) Equipment Required: Test Set with Mode S capability. Spectrum Analyzer (HP 8535A, or equivalent). Directional Coupler (HP 796D, or equivalent). ***Note:*** *For test equipment protection, the transponder transmitter modulation may be disabled by external means.* Measurement Procedure: Connect the equipment as shown in Figure 2-32. Do not interrogate the transponder. Measure the RF output power between squitter transmission periods.	**5.4.2.4 Residual Power Output** (Paragraph .) ***5.4.2.4.1 Test Equipment*** a. Transponder Test Set. b. Spectrum Analyser. c. Directional Coupler. ***5.4.2.4.2 Test Procedure*** Connect the equipment as shown in Figure 5-4. Either disable the transponder transmission modulation or inhibit squitter transmissions. Do not interrogate the transponder. Record the maximum power output, in the range of 1 090 ±3 MHz, with the transponder in the inactive state.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
 **Figure 2-32:**	
Reply Rate Capability Equipment Required: Mode S Transponder Test Set. Measurement Procedure: Step l Continuous Reply Rate Capability (§ ..a and § .) Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder at a constant rate of 500 ATCRBS interrogations per second plus 50 Mode S interrogations (with short replies) per second. Determine reply ratio for each type of interrogation. Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 16 (24 if also equipped with the enhanced data link protocols) of the 50 Mode S interrogations requiring long replies. Highlighted above is equal to ED-73C step 2.	**5.4.2.5 Reply Rate Capability** (Paragraph .) ***5.4.2.5.1 Test Equipment*** Transponder Test Set ***5.4.2.5.2 Test Procedure*** a. STEP 1 - Continuous Reply Rate Capability (Mode A/C) (Paragraph .) Set the transponder for a 15-pulse reply (Mode A with SPI) and set the reply rate limit control to maximum. Interrogate the transponder on Mode A at 500 interrogations per second. Gradually increase the interrogation rate while observing the reply count over 1-second intervals. Verify that the maximum reply rate is at least 1 200 replies per second for Class 1 transponders, and 1 000 replies per second for Class 2 transponders. STEP 2 - Continuous Reply Rate Capability (Mode S) (Paragraph .) (1) If the transponder has only short reply capability Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder at a constant rate of 500 Mode A interrogations per second, plus 50 Mode S interrogations (for short replies) per second. For at least 15 minutes verify that the transponder replies at the specified rates. (2) If the transponder has long reply capability but no Downlink ELM capability Perform the test listed in (1) using 16 of the 50

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	Mode S interrogations requiring long replies. (3) If the transponder has Level 4 capability Perform the test listed in (1) using 16 of the 50 Mode S interrogations requiring long replies. Additionally generate Downlink ELMs at the rate specified in Step 6 below. (4) If the transponder has Level 5 capability Perform the test listed in (1) using 24 of the 50 Mode S interrogations requiring long replies. Additionally generate Downlink ELMs at the rate specified in Step 6 below.
Step 2 100 Milliseconds Peak Reply Rate Capability (§ . b & c and § .) Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 120 ATCRBS interrogations (100 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by a 0.9-second interval with no interrogations. Determine reply ratio for each type of interrogation. Measure the output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 6 (9 if also equipped with the enhanced data link protocols) of the 18 Mode S interrogations requiring long replies.	c. STEP 3 - 100 Milliseconds Peak Reply Rate Capability (Mode S) (Paragraph .) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder with periodic bursts of Mode A and Mode S interrogations as follows: (1) 120 Mode A interrogations, plus 18 Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 0.1-second interval, followed by (2) a 0.9-second interval with no interrogations. Verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test using 6 of the 18 Mode S interrogations requiring long replies.
Step 3 25 Millisecond Peak Reply Rate Capability (§ .) Set the transponder for a 15-pulse ATCRBS reply. Interrogate the transponder with periodic bursts of ATCRBS and Mode S interrogations as follows: 30 ATCRBS interrogations (25 if the equipment is intended for installation in aircraft that operate at altitudes not exceeding 15,000 feet) plus eight Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by a 975-millisecond interval without interrogations. Determine reply ratio for each type of interrogation. Measure output power and frequency. If the transponder is equipped for long Mode S reply formats, repeat the test with 4 (6 if also equipped with the enhanced data link protocols) of the 8 Mode S interrogations requiring long replies.	d. STEP 4 - 25 Millisecond Peak Reply Rate Capability (Mode S) (Paragraph .) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder with periodic bursts of Mode A and Mode S interrogations as follows : (1) 30 Mode A interrogations plus 8 Mode S interrogations (requiring short replies), each type of interrogation burst approximately uniformly spaced within a single 25-millisecond interval, followed by (2) a 975-millisecond interval without interrogations. In each case, verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test using 4 of the 8 Mode S

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	interrogations requiring long replies.
Step 4 1.6 Milliseconds Peak Reply Rate Capability (§ . and § .) Repeat Step 3 with the following modification: Use two ATCRBS interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single l.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. Determine reply ratio for each type of interrogation. Measure output power and frequency. If the transponder is so equipped repeat the test with two of the four Mode S interrogations having long replies.	e. STEP 5 - 1.6 Milliseconds Peak Reply Rate Capability (Mode S) (Paragraph .) Set the transponder for a 15-pulse reply (Mode A with SPI). Interrogate the transponder with two Mode A interrogations plus four Mode S interrogations (with short replies), each type of interrogation approximately uniformly spaced within a single 1.6-millisecond interval, followed by a 998.4-millisecond interval with no interrogation. Verify that the transponder replies at the specified rate. If the transponder has long reply capability, repeat the test for two additional Mode S interrogations with long replies. f. STEP 6 - Mode S Peak Reply Rate (Paragraph .) ***NOTE:*** *This test need not to be repeated if it has already been performed as part of Step 2* Obtain the maximum number of segments (n) the transponder is declared to be capable of delivering. Calculate the additional number of segments (a) that the transponder is required to handle in a 25-millisecond interval each second as follows: a = n/4 (Rounded up) Load the transponder with a Downlink ELM with (n) segments. At Time = 0: Interrogate the transponder to extract (n) segments (i.e. the complete Downlink ELM). At Time = 24 milliseconds: Interrogate to extract (a) segments again (any segments of the downlink ELM can be chosen), then closeout the Downlink ELM Verify that all the segments were extracted correctly. Repeat the test once per second for 1 minute and verify that all the extractions were successful.
ATCRBS Reply Rate Limiting (§ .) Equipment Required: ATC Test Set (T-50-3A/4A (2 required), or equivalent). Wide Band Dual Channel Oscilloscope (HP 1710B, or equivalent). Frequency Counter (HP 5381A, or equivalent). Measurement Procedure: Connect the equipment as shown in Figure 2-27 and Figure 2-29.	**5.4.2.6 Reply Rate Limiting** (Paragraph .) ***5.4.2.6.1 Test Equipment*** a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. ***5.4.2.6.2 Test Procedure*** Connect the equipment as shown in Figures 5-5 and 5-6.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
 **Figure 2-29:**	
Step 1 Determination of Reply Rate Limit Set the Mode A code to 0000. Interrogate the transponder on Mode A with a signal 20 dB above MTL at a variable rate starting at 500 per second. Gradually increase the interrogation rate while observing the reply count over 1-second intervals. The highest count observed is the reply rate limit. Verify that it does not exceed 2000 continuous replies per second.	a. STEP 1 - Determination of Mode A/C Reply Rate Limit With the Mode A code set to 0000, interrogate the transponder on Mode A at a rate greater than 2 000 interrogations per second. Record the reply rate at the maximum and minimum settings of the reply rate limit control. Set the reply rate limit control to 1 200 replies/sec or the maximum rate below 1 200 replies/sec for Class 2 transponders.
	b. STEP 2 - Mode S Reply Rate limiting (Paragraph .) ***NOTE:*** *This test only needs to be performed if a reply rate limiting device is provided.* Interrogate the transponder with standard UF=4 interrogation requiring a long reply at a rate equal to 1.5-times the Mode S reply rate limit. Record the squitter reply rate. For a transponder equipped with the optional long air-air formats, interrogate the transponder as above and with interrogations requiring a DF=16 reply at a rate of 10 interrogations per second and record the DF=16 reply rate.
Step 2 Sensitivity Reduction Set the transponder's Mode C code to 0000 and its Mode A code to any value other than 0000. Interrogate the transponder with the sum of a) a Mode C interrogation 20 dB above MTL at a continuous rate equal to the reply rate limit determined in Step 1 and b.) a second unsynchronized Mode A interrogation 3 dB above MTL at a	c. STEP 3 - Sensitivity Reduction Set the transponder Mode C code to 0000 and the Mode A code to any value other than 0000. Interrogate the transponder with : (1) Mode C interrogations at MTL+20dB at a continuous rate of 1 200 interrogations/sec, and

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
continuous rate equal to 50% of the reply rate limit determined in Step 1. Verify that the transponder replies to at least 90% of the interrogations at the signal level 20 dB above MTL and that it does not reply to more than 10% of the interrogations at the signal level 3 dB above MTL.	(2) unsynchronised Mode A interrogations at MTL+3dB, at a continuous rate of 600 interrogations/sec Verify that the transponder replies to at least 90% of the Mode C interrogations at the signal level of MTL+20dB, and that it does not reply to more than 10% of the Mode A interrogations.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
2.4.2.7 Response to Interference (§ .) Equipment Required: Mode S Transponder Test Set. ATC Test Set (TIC T-50-3A/4A, or equivalent). Wide Band Dual Channel Oscilloscope (HP 1710B, or equivalent). 3 Port Power Divider (Weinschel 1506, or equivalent). Measurement Procedure: With the equipment connected as shown in Figure 2-27, interrogate the transponder with the standard Mode S-Only All-Call interrogation at a signal level of -50 dBm and follow Steps l through 4 below. Step 1 Low Level Asynchronous Interference (§ .) Insert a 0.8-microsecond wide pulse [defined in § ..i (ll)] with amplitude 12 dB below P_1 of the standard Mode S-Only All Call at a repetition rate of 10,000 Hz. Measure reply ratio. Repeat the test for all signal levels between -65 and -21 dBm in 5-dB increments. ***Note:*** *Take care to avoid synchronization of the 10,000 Hz rate with the Mode S standard rate.* Step 2 Standard Interference Pulse (§ .) and Mode S SLS (§ .) Insert the interfering pulse (duration: 0.8 microsecond, level 6 dB below P_6) at a position l.8 microseconds after the leading edge of P_6 of a standard Mode S-Only All-Call. Observe the reply ratio while slowly moving the interfering pulse from its initial position to the end of P_6. Repeat the test for all signal levels between -68 and -21 dBm in 5-dB increments. Repeat the test with an interference pulse level 3 dB below the P_6 level. Insert the interfering pulse (now acting as P_5) 0.85 microsecond after the leading edge of P_6 and use a level 3 dB above the level of P_6. Use signal levels between MTL +3 dB and -21 dBm in 5-dB increments. Reply ratio in all cases should be 10 percent or less (§ ..a). Reduce level of P_5 to a value 12 dB below the level of P_6 and repeat the test at signal levels from MTL +3 dB to -21 dBm in 5-dB increments. Reply ratio should be 99 percent or more (§ ..b). Step 3 Pulse Pair Interference (§ .) Insert a 0.8 microsecond pulse pair spaced 2.0 microseconds	**5.4.7 Response in the Presence of Interference (Paragraph 3.12)** **5.4.7.1 Test Equipment** a. 2 Transponder Test Sets. b. Wide Band Dual Channel Oscilloscope. c. 3 Port Power Divider. **5.4.7.2 Test Procedure** With the equipment connected as shown in Figure 5-5, interrogate the transponder with the Mode S-Only All-Call interrogation at a signal level of -50 dBm and follow Steps 1 through 4 below. a. STEP 1 - Low Level Asynchronous Interference (Paragraph .) Inject a 0.8 µs wide pulse with amplitude 12 dB below the P1 of the Mode S-Only All-Call, at a repetition rate of 10 000 Hz. Record the reply ratio. ***NOTE:*** *Take care to avoid synchronisation of the 10 000 Hz rate with the Mode S standard rate.* b. STEP 2 - Standard Interference Pulse and Mode S SLS (Paragraphs . and .) lnsert the interfering pulse (duration: 0.8 µs, level: 6 dB below P6) at a position 1.8 µs after the leading edge of P6 of a Mode S-Only All-Call. Record the minimum reply ratio observed while slowly moving the interfering pulse from its initial position to the end of P6. Repeat the test for all signal levels between -68 and -21 dBm in 5 dB increments. Repeat the test with an interference pulse level 3 dB below the P6 level. Inject the interfering pulse (now acting as P5) 0.85 µs after the leading edge of P6 and use a level 3 dB above the level of P6. Use signal levels between MTL+3dB and -21 dBm in 5 dB increments. Record the maximum reply ratio in each case. Reduce level of P5 to a value 12 dB below the level of P6 and repeat the test at signal levels from MTL+3dB to -21 dBm in 5 dB increments. Record the minimum reply ratio in each case. c. STEP 3 - Pulse Pair Interference (Paragraphs . a, b, and c)

DO-181D version 0.6		ED-73C after WG-49 Meeting 9	
	apart [§ ..i(11)] with amplitude 9 dB below P_1 of the standard Mode S-Only All-Call, at a position such that the leading edge of the pulse pair occurs 0.25 microseconds after the leading edge of P_1. Record the reply ratio while moving the interfering pulse pair in 0.25 microsecond steps from its initial position to a position 0.25 microseconds after the falling edge of P_6. Determine the average reply efficiency from the recorded values. Repeat the test for all input levels between –68 dBm and –21 dBm in 5-dB increments.		Insert a 0.8 µs pulse pair spaced 2.0 µs apart with amplitude 9 dB below P1 of the standard Mode S-Only All-Call, at a position such that the leading edge of the pulse pair occurs 0.25 µs after the leading edge of P1. Record the reply ratio while moving the interfering pulse pair in 0.25 µs steps from its initial position 0.25 µs after the trailing edge of P6. Determine the average reply efficiency from the recorded values. Repeat the test for all input levels between -68 and -21 dBm in 6 dB increments.
Step 4	DME and JTIDS Interference Tests (§ .) Insert 3.5-microsecond wide pulse pairs spaced 12 microseconds apart with amplitudes of -30 dBm at a rate of 3,600 randomly spaced pulse pairs per second. Observe the reply ratio as the frequency of the interfering signal is varied over the ranges of 962 to 1020 MHz and 1041 to 1213 MHz. Repeat the test using 3.5-microsecond wide pulse pairs spaced 30 microseconds apart. Repeat the test using 6.4-microsecond wide pulse pairs at a random rate of 2000 pulses per second, with an amplitude of -80 dBm and a frequency of 1030 MHz.	d.	STEP 4 - DME and Other Spurious Pulse Interference Tests (Paragraph .) Inject pairs of pulses, of duration 3.5 µs, spaced 12 µs apart with amplitude of -30 dBm at a rate of 3 600 pulse pairs per second. Record the reply ratio observed as the frequency of the interfering signal is varied over the ranges of 962 to 1 020 MHz, and 1 041 to 1 213 MHz. Repeat the test using pulses spaced 30 µs apart. Repeat the test using single pulses of 6.4 µs duration at a rate of 2000 pulses per second, with an amplitude of -80 dBm and a frequency of 1 030 MHz.
		e.	STEP 5 - Standard Interference Pulse Positioned at Mode A or Mode C Spacing before P1 of a Mode S Interrogation (Paragraphs . a and . d) Insert standard interfering pulse 8 µs before, and at the same signal level as, the P1 pulse of a standard Mode S only All-Call interrogation. Check and record that the transponder replies to the Mode S only All-Call interrogation. Insert a standard interfering pulse 21 µs before, and at the same signal level as, the P1 pulse of a standard Mode S only All-Call interrogation. Check and record that the transponder replies to the Mode S only All-Call interrogation. ***NOTE:*** *This test checks that the suppression pair is the recognised pulse pair by testing that the following P6 is correctly decoded.*
		f.	STEP 6 - Mode A and Mode C with Standard Interfering Pulse (paragraph .) Overlay a Standard random Interfering Pulse over

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	proper Mode A and Mode C interrogations with a level 10 dB below the level of the Mode A/C interrogations. Check and record that the transponder replies to at least 90 % of the Mode A and Mode C interrogations and does not recognise the random interference pulse as P1, P2 or P3.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
2.4.2.12 Data Handling and Interfaces (§ .) The procedures outlined in this paragraph are intended only to test "data in" and "data out" requirements of the transponder. They do not constitute tests of the transponder's digital logic and protocols. Some tests correspond to requirements of optional features, and therefore are not applicable to all transponders.	**5.4.12 Data Handling and Interfaces** (Paragraph .) The procedures outlined in this paragraph are intended only to test "data in" and "data out" requirements of the transponder; they shall not be interpreted as being tests of the transponder's digital logic and protocols. Some tests correspond to requirements of optional features, and therefore do not apply to all transponders.
2.4.2.12.1 Fixed Direct Data (§ .) Equipment Required: Mode S Transponder Test Set (§ ..i). Measurement Procedure: With the transponder RF port connected to the RF port of the Mode S transponder test set, perform the following test sequences.	**5.4.12.1 Fixed Direct Data** (Paragraph . a.) ***5.4.12.1.1 Test Equipment*** a. Transponder Test Set. b. Wide band dual channel oscilloscope. ***5.4.12.1.2 Test Procedure*** With the transponder RF port connected to the RF port of the Transponder Test Set, (Figure 5.3) perform the following test sequences:
Step 1 Mode S All-Call Addresses [§ ..a (l)] Interrogate the transponder with a Mode S-Only All-Call interrogation with PR and II Fields set to 0. Verify that the AA field of the transponder reply reflects the address which has been set into the transponder. Twenty-four different addresses consisting of 23 ZEROs and a single ONE **shall** be tested. DO-181C modified to conform with ED-73C	a. STEP 1 - Mode S All-Call Address Announced (AA) Field Interrogate the transponder with a Mode S - Only All-Call interrogation with PR, IC and CL Fields set to 0. Record that the AA field of the transponder reply contains the address which has been set at the transponder interface. Repeat with twenty-four different transponder addresses each consisting of 23 ZEROs and a single ONE.
Step 2 Mode S Discrete Address [§ ..a (2)] Interrogate the transponder with a standard Mode S surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to 0 and an address consisting of ONE followed by 23 ZEROs. Verify that the transponder replies with appropriate bits set in the AP field when a like address is set into the transponder, and will not respond when each of the other combination of 23 ZEROs and a single ONE are entered as addresses.	b. STEP 2 - Mode S Discrete Address Interrogate the transponder with a Mode S surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to 0 and an address consisting of ONE followed by 23 ZEROs. Record that the transponder replies with appropriate bits set in the AP field when the same address is set at the transponder interface, and does not respond when each of the other combination of 23 ZEROs and a single ONE are entered as addresses.
Step 3 Maximum Airspeed (§ ..b) Interrogate the transponder with a short special surveillance interrogation (UF=0) with the AQ field set to 1. Verify that the RI field of the transponder reply corresponds to the airspeed code set into the transponder as each of the seven possible airspeed codes is used.	c. STEP 3 - Maximum Cruising True Airspeed Interrogate the transponder with a short special surveillance interrogation (UF=0) with the AQ field set to 1. Record that the RI field of the transponder reply corresponds to the maximum cruising true airspeed

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	code set at the transponder interface as each of the seven possible maximum cruising true airspeed codes is used.
Step 4 Aircraft Identification Data (§ ..c) If the transponder inputs aircraft identification data as fixed data, the following test applies. Interrogate the transponder with a short surveillance-altitude (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 'LLLLLLLL' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 001100001100 ...) of the transponder's reply. Repeat with an aircraft identification input of '33333333' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 110011110011 ...) of the transponder's reply.	d. STEP 4 - Aircraft Identification Data Interrogate the transponder with a short surveillance-altitude interrogation (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 101010.....(etc) and record that the identification data are properly transmitted in the MB field of the transponder's reply. Repeat for an aircraft identification input of 010101.....(etc). Repeat with an aircraft identification input of ABCD1234 coded in accordance with the character coding specified in paragraph . f.
DO-181D will be updated to include edited version of the ED-73C Step 5	e. Step 5 – Invalid AA Put the transponder in the Power Off Condition and set the AA to all ZEROs. Turn on the transponder and verify that a transponder error condition is set. Note : the transponder will normally either go into Standby State, revert to a pure Mode A/C transponder or return to the Power Off Condition. Repeat this test with the AA set to all ONEs. Put the transponder in the Power On Condition with an AA set to ONE for the first bit and ZEROs for all other bits. Verify that the transponder functions normally as indicated in steps 1 and 2. Without putting the transponder in Power Off Condition change the AA to all ZEROs. Verify that the transponder generates a diagnostic error message for maintenance and that it keeps operating using the initial AA read during the power-on initialisation process (first bit set to ONE and all other bits set to ZEROs). Repeat this test with the AA set to all ONEs. Repeat with the remaining twenty-three different transponder addresses each consisting of 23 ZEROs and a single ONE

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
2.4.2.12.2 Variable Direct Data (§ .) Equipment Required: Mode S Transponder Test Set. ATC Test Set (T-50-3A/4A, or equivalent). Wide Band Dual Channel Oscilloscope (HP 1710B, or equivalent). Step 1 Pressure Altitude (ATCRBS) [§ ..a (l)] Connect the equipment as shown in Figure 2-26. Interrogate the transponder with a standard ATCRBS Mode C interrogation. With the ALT switch on, set altitude code inputs to the transponder, which should result in setting each of the altitude bits in the reply one at a time. Verify proper positioning of these bits in the reply. Verify that only the framing pulses are present in the reply when the ALT switch is set to "off." Step 2 4096 Identification Code (ATCRBS) (§ ..b) With equipment connected as in Step l, interrogate the transponder with a standard ATCRBS Mode A interrogation. Set identification codes which should result in the setting of each of the identification reply bits one at a time. Verify proper positioning of these bits in the reply. Step 3 Pressure Altitude (Mode S) [§ ..a (2)] Connect the transponder RF port to the Mode S test set. Interrogate the transponder with a standard surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. With the ALT switch on, provide altitude code inputs to the transponder which should result in setting each of the ac field bits (including the M bit or the Q bit if the transponder is equipped to report altitude in 25-foot increments) of the reply one at a time. Verify that the correct bits are transmitted in the ac field of the reply.	**5.4.12.2 Variable Direct Data (Paragraph . b.)** ***5.4.12.2.1 Test Equipment*** a. Transponder Test Set. b. Wide Band Dual Channel Oscilloscope. ***5.4.12.2.2 Test Procedure*** Connect the equipment as shown in Figure 5-3. a. STEP 1 - Pressure Altitude (Mode A/C) Interrogate the transponder with a Mode C interrogation. With the ALT switch on, set altitude code inputs to the transponder in a manner which should result in setting each of the altitude bits in the reply one at a time. Verify the proper positioning of these bits in the reply. Verify that only the framing pulses are present in the reply when the ALT switch is set to "OFF". Set the input altitude data to invalid and interrogate the transponder with a Mode C interrogation. Verify that a reply is generated containing only the framing pulses. b. STEP 2 - 4096 Identification Code (Mode A/C) Interrogate the transponder with a Mode A interrogation. Set identification codes which should result in the setting of each of the identification reply bits one at a time. Record proper positioning of these bits in the reply. c. STEP 3 - Pressure Altitude (Mode S) (1) Connect the transponder RF port to the transponder test set. (2) Interrogate the transponder with a standard surveillance-altitude interrogation (UF=4) with the PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. (3) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised to greater than 25 ft to the transponder which should result in setting each of the AC field bits of the reply, one at a time. (4) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 0 and the M bit set to 0. (5) With the ALT switch ON, provide altitude code inputs from an altitude source in feet quantised

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	to 25 ft or less to the transponder and verify that the altitude report is correct as a minimum when the input indicates pressure altitudes of 17 050 and 34 125 ft. (6) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 1 and the M bit set to 0. (7) With the ALT switch ON, provide altitude code inputs from an altitude source quantised to 25 ft or less to the transponder. Verify that the altitude report is correct when the input indicates pressure altitudes of between 50 188 ft and 126 700 ft, which should result in setting each of the AC field bits of the reply. (8) Verify that the correct bits are transmitted in the AC field of the reply with the Q bit set to 0 to indicate a report to 100 ft quantisation and the M bit set to 0. (9) Repeat Step 3 (1) to (8) with the input indicating metric input if available and verify that the M bit is set to 1 in the AC field of all replies.
Updates §2.5.4.10 to add a step for "M" bit set to 1 And to provide invalid data and verify that the AC field is set to all ZEROs.	
Verify that the ac field is all ZEROs when the ALT switch is set to "off."	Verify that the AC field is all ZEROs when the ALT switch is set to " OFF ". Set the input altitude data to invalid and verify that the AC field is all ZEROs.
Step 4 Identification Code (Mode S) (§ ..b) With the equipment connected as in Step 3, interrogate the transponder with a standard surveillance-identity interrogation (UF=5) with PC, RR, DI and SD fields set to ZERO and the address the same as that provided to the transponder. Using the identity codes specified in Step 2, verify that the proper bit patterns exist in the ID field of the reply.	d. STEP 4 - The 4096 Identification Code (Mode S) With the equipment connected as in STEP 3, interrogate the transponder with a standard surveillance-identity interrogation (UF=5) with PC, RR, DI and SD fields set to ZERO. Using the identification codes specified in STEP 2, record that the proper bit patterns exist in the ID field of the reply.
Step 5 Flight Status and Vertical Status (§ ..c) Interrogate with UF=0 and UF=16 and verify that the VS field is a ONE when the "on-the-ground port" of the transponder is set to the on-the-ground condition. Also, verify that the VS field is a ZERO otherwise. Interrogate with formats UF=4, 5, 20, 21 and verify that the transponder follows the protocol of § ., and Figure 2-13.	e. STEP 5 - Flight Status and Vertical Status Interrogate with UF=0 and UF=16 and record that the VS field is a ONE when the "on-the-ground" port of the transponder is set to the "on-the-ground" condition, and a ZERO otherwise. Interrogate with formats UF=4, 5, 20, 21 and record that the above indications are correctly contained in the FS field and that CA is set to 4 (airborne) or 5.(ground), if a status is provided to the transponder,

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
	and code CA=6 (either airborne or on-the-ground) is reported when the input is idle (or not available).
Step 6 Aircraft Identification Data (§ ..e) If the transponder inputs aircraft identification data as variable data, the following test applies. Interrogate the transponder with a short surveillance-altitude (UF=4) with PC, DI and SD fields set to 0 and the RR field set to 18. Set the aircraft identification input to the transponder to 'LLLLLLLL' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 001100001100 ...) of the transponder's reply. Repeat with an aircraft identification input of '33333333' and verify that the encoded aircraft identification data is correctly transmitted in the MB field (MB Bits 9-56 = 110011110011 ...) of the transponder's reply.	f. Step 6 – Invalid AA Put the transponder in the Power Off Condition and set the AA to all ZEROs. Turn on the transponder and verify that a transponder error condition is set. Note : the transponder will normally either go into Standby State, revert to a Mode A/C transponder or return to the Power Off Condition. Repeat this test with the AA set to all ONEs. Put the transponder in the Power On Condition with an AA set to ONE for the first bit and ZEROs for all other bits. Verify that the transponder functions normally as indicated in steps 1 and 2.
Action Item taken to review	Without putting the transponder in Power Off Condition change the AA to all ZEROs. Verify that the transponder generates a diagnostic error message for maintenance and that it keeps operating using the initial AA read during the power-on initialisation process (first bit set to ONE and all other bits set to ZEROs). Repeat this test with the AA set to all ONEs. Repeat with the remaining twenty-three different transponder addresses each consisting of 23 ZEROs and a single ONE.
2.4.2.12.3 Standard Transaction Interfaces (§ .)	**5.4.12.3 Standard Transaction Interfaces (Paragraph .)**
Equipment Required: Mode S Transponder Test Set. Means of Inserting and Extracting Data at Transponder Interface Ports. Means of Timing Transactions.	***5.4.12.3.1 Test Equipment*** a. Transponder Test Set. b. A means of injecting and extracting data at transponder interface ports. c. A means of timing transactions.
Measurement Procedures: With the transponder RF port connected to the RF port of the Mode S Transponder Test Set, perform the following test sequences.	***5.4.12.3.2 Test Procedure*** Connect the equipment as shown in Figure 5.1.
Step l Uplink Interface Information Content (§ . a and e) Interrogate the transponder with valid Mode S interrogations of all uplink formats which the transponder is designed to accept, including broadcast interrogations. Verify that all	a. STEP 1 - Uplink Interface Information Content (Paragraph . c.) Interrogate the transponder with valid Mode S interrogations excluding UF 0, UF 11 and UF 16 of all

DO-181D version 0.6		ED-73C after WG-49 Meeting 9	
	fields (possibly excluding AP) of the interrogations are passed correctly through the transponder and except for UF=0, 11, 16, and 24 (when it is a request for a downlink ELM), appear at the uplink interface. Make additional valid interrogations with the uplink formats (excluding UF=11 and UF=24) and field content randomly chosen. Verify proper output of the uplink interface. Verify that broadcast interrogations are identified as such, either by AP content or by a special purpose code.		uplink formats which the transponder is designed to accept, including broadcast interrogations. Record that all fields (possibly excluding AP) of the interrogations are passed correctly through the transponder and appear at the uplink interface. Make additional valid interrogations with the Uplink Formats and field content randomly chosen. Record proper output of the uplink interface. Verify and record that broadcast interrogations are identified as such, either by AP content or a special purpose code.
Step 2	Uplink Interface, "No-Storage Design" (§ ..b) Interrogate the transponder with valid Mode S interrogations of all uplink formats which the transponder is designed to accept. Verify that all data appear correctly at the uplink interface prior to the start of the transponder reply.	b.	STEP 2 - Uplink Interface, "No-Storage" Design (Paragraph . c.) Interrogate the transponder with valid Mode S interrogations (including broadcast but excluding UF=11 and UF=24) of all Uplink Formats which the transponder is designed to accept. Record that all data appear correctly at the uplink interface prior to the start of the transponder reply.
	Action taken for WG-49 to review the exclusion of UF=24)		
Step 3	Uplink Interface, "Storage Design" Acceptance Rate (§ ..c) Interrogate the transponder with valid Mode S interrogations (both short and long) at the rates and time periods specified in § .. Verify that all data appear correctly at the uplink interface.	c.	STEP 3 - Uplink Interface, "Storage Design" Acceptance Rate (Paragraph . c.) Interrogate the transponder with valid Mode S interrogations (both short and long) at the rates and time periods specified in Paragraph . c. Record that all data appear correctly at the uplink interface.
Step 4	Uplink Interface, Nonacceptance (§ ..d) Interrogate the transponder with valid long Mode S interrogations at a rate exceeding the one specified in § . for the longest time period. Verify that the transponder does not accept interrogations after the rate for which the transponder is designed. Also, verify that all data correctly appear at the uplink interface for all accepted interrogations. WG-49 to review.	d.	STEP 4 - Uplink Interface, Non-acceptance (Paragraph . c.) Interrogate the transponder with valid long Mode S interrogations at a rate exceeding the one specified in Paragraph . c.(4) for the longest time period. Record that the transponder does not accept interrogations after the rate for which the transponder is designed has been exceeded. Record that all data correctly appear at the uplink interface for all accepted interrogations. With the uplink interface disconnected record that the transponder does not reply to valid long Mode S interrogations.
Step 5	Downlink Interface, Information Content (§ ..a) Insert an all ONEs input. Interrogate the transponder with all uplink formats that it is designed to accept (one interrogation of each format, RR=16 for long interrogations). Verify that	e.	STEP 5 - Downlink Interface, Information Content (Paragraph . d.) Inject an all ONEs input directed to the MB message buffer accessed by RR = 16.

DO-181D version 0.6		ED-73C after WG-49 Meeting 9	
	all bits in the transponder replies, not set by transponder protocol requirements, are ONE. Verify that all fields in the replies, set by transponder protocol, have the correct value. Sentence copied into DO-181D		Interrogate the transponder with all Uplink Formats that it is designed to accept (one interrogation of each format, RR=16 for long interrogations). Record that all bits in the transponder replies, not set by transponder protocol requirements, are ONE. Record that all fields in the replies, set by transponder protocol, have the correct value. Repeat the 3 previous points with MB field data context 55 5555 5555 5555.
Step 6	Downlink Interface, "No-Storage Design" (§ ..b) Insert an all ONEs input. Interrogate the transponder with a standard Comm-A, altitude interrogation. Verify that data are inserted into the transponder at the proper time, and that the transponder reply contains the proper data.	f.	STEP 6 - Downlink Interface, "No-Storage Design" (Paragraph . d.) Insert an all ONEs input, directed to the BDS buffer, accessed by RR=20. Interrogate the transponder with a standard Comm-A, altitude interrogation. Record that the transponder reply contains the correct data.
Step 7	Downlink Interface, "Storage Design" Buffer Rate, Buffer Function (§ ..c) Set up a sequence of Comm-B replies with the value of the last 48 bits of MB of each reply set to the number of the reply in the sequence (e.g., MB=1 for first reply). Interrogate the transponder with a standard Comm-A, altitude interrogation at the rates specified for long interrogations in § .. Verify that the replies include the proper data in the MB field. Repeat with RR equal to all valid codes from 16 through 18. Procedures are functionally equal and will remain unchanged.	g.	STEP 7 - Downlink Interface, "Storage Design" Buffer Rate, Buffer Function (Paragraph . d.) Set up a sequence of Comm-B replies, associated with a specific BDS data source designator code, with the value of the 56 bit MB field of each reply set to a number to enable verification of reply sequence (e.g. value =2n where n is the number of the reply in the sequence). Apply this sequence of replies to the transponder down link interface at the rate specified for long interrogations in paragraph . d. Interrogate the transponder with a standard Comm-A, altitude interrogation requesting the BDS data source designator under test at the rate specified for long interrogations in paragraph . d. Record that the replies include the correct data in the MB field. Repeat for all valid BDS data source designator codes 0 to 255. ***NOTE:*** *BDS code 0 represents AICB messages. Testing of such messages requires such messages to be closed-out after being read.*
Step 8	Downlink Interface, Unavailable Data (§ ..e) Disconnect all inputs from the transponder's downlink interface port. Interrogate the transponder with a standard Comm-A, altitude interrogation containing RR=16. Verify that the reply contains all ZEROs in the MB field. Repeat	h.	STEP 8 - Downlink Interface. Unavailable Data (Paragraph . d.) Disconnect all inputs from the transponder's downlink interface port. Interrogate the transponder with a standard Comm-A,

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
with all RR codes from 17 through 31. Copied the first three bullets into DO-181C and indicated them as a "note"	altitude interrogation containing RR=16. Record that the reply contains all ZEROs in the MB field. Repeat with all RR codes from 17 through 31. Verify that: - For RR code 17, bits of the MB field of the reply excluding bits 1-8, 24, 26-32, 33 and 35 are set to ZEROs (bits 1-8, 24, 26-32, 33 and 35 are or may eventually be set by the transponder itself when no interface is available). - For RR code 18, the reply contains either all ZEROs in the MB field if the aircraft identification consists of variable direct data, or the tail number if the aircraft identification consists of fixed direct data. - For RR code 19, bits 9-56 of the MB field of the reply are set to ZEROs. For RR codes 20 though 31, verify that the reply contains all ZEROs in the MB field.
2.4.2.12.4 ELM Service Interfaces (§ . and § .) Equipment Required: Mode S Transponder Test Set. Transponder ELM Data Link Device. Measurement Procedure: Connect the transponder RF port to the RF port of the Mode S transponder test set. Connect the Mode S transponder test set of the ELM data link device to the ELM interface port of the transponder and perform the following sequences. Step 1 ELM Uplink Interface, Data Rate (§ .) Interrogate the transponder with four 16-segment uplink ELMs (each segment having unique coding, interrogations spaced 50 microseconds apart, and a new 16-segment ELM starting 5 milliseconds after the previous ELM). After 4 seconds for transponders equipped for standard ELM operation or after 1 second for transponders equipped for enhanced uplink ELM operation, interrogate the transponder with another set of four 16-segment ELMs. Verify that the correct data appears at the ELM interface no later than one second after completion of the corresponding uplink ELM for both interrogation sequences. Verify that the interface reports an interrogator identity code of ZERO. Step 2 ELM Uplink Interface, Interrogator Identification (§ .) Repeat the procedures of Step 1 using the multisite protocol. Use different Interrogator Identifier codes and verify that	**5.4.12.4 ELM Service Interfaces (Paragraph .)** ***5.4.12.4.1 Test Equipment*** a. Transponder Test Set. b. Transponder ELM Data Link Device. ***5.4.12.4.2 Test Procedure*** Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the ELM data link device to the ELM interface port of the transponder and perform the following sequences. a. STEP 1 - ELM Uplink Interface, Data Rate (Paragraph . c.) Interrogate the transponder with four 16-segment uplink ELMs (each segment having unique coding) with interrogations spaced 50 µs apart, and a new 16-segment ELM starting each second. After 4 seconds, interrogate the transponder with another set of four 16-segment ELMs. Record that correct data appear at the ELM interface, within one second after completion of the delivery of the corresponding uplink ELM, for both interrogation sequences. WG-49 to add sentence to above paragraph Verify that the interface reports an interrogator identifier code of 0. b. STEP 2 - ELM Uplink Interface, Interrogator Identification (Paragraph . e)

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
they are correctly reported at the interface. Step 3 ELM Downlink Interface, Data Rate (§ . and § .) Set up a downlink ELM which conforms to the maximum capability of the transponder (each segment with unique coding) on the Mode S transponder test set or ELM data link device. Interrogate the transponder with a Comm-C (UF=24) with RC=3 and SRS="all ONEs." Verify that all segments are properly transmitted 136 ±1 microseconds apart.	Repeat STEP 1 using the multisite protocol. Use different Interrogator Identifier codes and verify that they are correctly reported at the interface. c. STEP 3 - ELM Downlink Interface, Data Rate (Paragraph . d.) Set up a downlink ELM which conforms to the maximum capability of the transponder (each segment with unique coding) on the Transponder Test Set or ELM data link device. Interrogate the transponder with a Comm-C (UF=24) with RC=3 and SRS="all ONEs". Check that all segments are correctly transmitted 136 ±1 µs, apart.
2.4.2.12.5 Interface Integrity Testing (§ .) Compliance with this requirement **shall** be demonstrated either by direct test in a simulated operational environment or by analysis based on the known characteristics of proven interface techniques.	**Duplicated in ED-73C §5.4.13, no changes**
2.4.2.12.6 Comm-B Downlink Interface, Message Cancellation (§ .)	**5.4.12.5 Comm-B Downlink Interface, Message Cancellation (Paragraph .)** ***5.4.12.5.1 Test Equipment*** a. Transponder Test Set. b. Transponder Data Link Device. ***5.4.12.5.2 Test Procedure*** Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the data link device to the interface port of the transponder and perform the following sequences.
Step 1 Cancellation Before Transmission Insert a Comm-B message into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21 and verify that the DR code in its replies is set to 1. Cancel the message via the interface, interrogate again and verify that the DR code is now not 1. Difference agreed to be functionally equal, no change.	a. STEP 1 - Cancellation Before Transmission Interrogate the transponder with UF=4, 5, 20 and 21 and RR ≠16. Verify that the DR code in the transponder reply is set to 0. Insert a Comm-B message into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21 in turn. Verify that the DR code in its replies is set to 1. Cancel the message via the interface, interrogate again to verify that the DR code is set to zero.
Step 2 Cancellation After Transmission Insert message as in Step 1, interrogate and extract message as in § ., using RR=16. Cancel message via the interface, interrogate again to verify that that DR is now not	b. STEP 2 - Cancellation After Transmission Interrogate the transponder with UF=4, 5, 20 and 21, RR ≠ 16 and verify that the DR code is set to 0. Insert a Comm-B message into the downlink interface for transmission.

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
Difference agreed to be functionally equal, no change.	Interrogate the transponder with UF=4, 5, 20 or 21 and extract the message using RR=16. Cancel the message via the interface, interrogate again with UF = 4, 5, 20 or 21 with RR = 16 to verify that the DR code in the transponder reply is set to zero.
Step 3 Cancellation in Multisite Environment Prepare two messages of differing content, m1 and m2, for insertion into the interface. Insert m1 as in Step 1 and extract using the multisite protocol (RR=16, DI=1, IIS>0, MBS=1). Cancel m1 via the interface and verify that DR is not 1 and that the UM field does not show a Comm-B reservation. After that verification, and within less than 15 seconds, insert m2 into the interface and extract using the multisite protocol with different IIS. Verify that the second message has been extracted and close out the transaction using DI=1, IIS as for m2, MBS=2 (see § .). Verify that DR is not 1 and that the UM field does not show a Comm-B reservation. ***Note:*** *This two-message sequence is needed to verify that a complete cancellation has been achieved by way of the interface.*	c. STEP 3 - Cancellation in Multisite Environment Interrogate the transponder with UF=4, 5, 20 and 21 and verify that the DR code is set to 0. Prepare two messages, m1 and m2, of differing content, for insertion into the interface. Insert m1 into the downlink interface for transmission and extract message using the multisite protocol (RR=16, DI=1, IIS more than 0, MBS=1). Cancel m1 via the interface and reinterrogate to verify that the UM field does not show a Comm-B reservation and that the DR code in the transponder reply is set to zero. Within less than 15 seconds of cancelling m1, insert m2 into the interface and extract using the multisite protocol with different IIS. Verify that the second message has been extracted and close out the transaction using DI=1, IIS as for m2, MBS=2. Verify that the DR field in the transponder reply is set to zero and that the UM field does not show a Comm-B reservation. ***NOTE:*** *This two-message sequence is needed to verify that a complete cancellation has been achieved by way of the interface.*
Step 4 Cancellation Within a Queue If the interface is designed to store more than one message in the transponder, where one message is ready to be transmitted and other messages are queued for subsequent transmission, the following test must be performed. Insert the maximum number of messages into the transponder and cancel one of the messages that is not scheduled for immediate transmission. Extract all messages and verify that the cancelled message does not appear. Repeat for each possible message location in the queue.	d. STEP 4 - Cancellation Within a Queue If the interface is designed to store more than one message in the transponder, where one message is ready to be transmitted and other messages are queued for subsequent transmission, the following test shall be performed. Insert the maximum number of messages into the transponder and cancel via the data interface one of the messages that is not scheduled for immediate transmission. Extract all messages and verify that the cancelled message does not appear. Repeat the test for each possible message location in the queue.
2.4.2.12.7 Downlink ELM Interface, Message Cancellation (§ .)	**5.4.12.6 Downlink ELM Interface, Message Cancellation (Paragraph .)**

DO-181D version 0.6	ED-73C after WG-49 Meeting 9
Step 1 Cancellation Before Transmission Insert an ELM message occupying as many segments as the transponder will permit into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21 and verify that the DR code in its replies is larger than 16 and reflects the number of inserted segments correctly. Cancel the message via the interface, interrogate again, and verify that the DR code is now not larger than 16. Step 2 Cancellation After Transmission Insert message as in Step 1, interrogate and extract message as in § **.**, using RC=3. Cancel message via the interface, interrogate again to verify that DR is now not larger than 16. Difference agreed to be functionally equal, no change.	***5.4.12.6.1 Test Equipment*** a. Transponder Test Set. b. Transponder ELM Data Link Device. ***5.4.12.6.2 Test Procedure*** Connect the equipment as shown in Figure 5-1. Connect the Transponder Test Set or the ELM data link device to the ELM interface port of the transponder and perform the following sequences. a. STEP 1 - Cancellation Before Transmission Insert an ELM message, occupying as many segments as the transponder will permit, into the downlink interface for transmission. Interrogate the transponder with UF=4, 5, 20 and 21. Verify that the DR code in the replies is larger than 16 and correctly reflects the number of inserted segments. Cancel the message via the interface. Interrogate again and verify that the DR code is now not larger than 16. b. STEP 2 - Cancellation After Transmission Insert an ELM message, occupying as many segments as the transponder will permit, into the downlink interface for transmission. Extract the message with a valid interrogation UF=24 using RC=3 and SRS set to extract the correct number of segments. Cancel the message via the interface. Interrogate again and verify that the DR code is now not larger than 16.
Not in DO-181 v06 Appears in DO-181D at §2.3.2.12	**5.4.14 Power Interruption (Paragraph .)** Apply the momentary power interruption sequence appropriate for the transponder environmental category as specified in ED-14D Section 16. Two seconds after the restoration of power following each power interruption, interrogate the transponder with a Mode S-only All-Call interrogation (UF=11) with IC and CI equal to 0. Verify that a correct All-Call reply (DF=11) is transmitted in response to this interrogation.